PICTURE OF THE MONTH

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Mesoscale cloud patterns are strongly influenced by the terrain features of an area. A frequently observed example is the formation of wave clouds in the area of gravity waves to the lee of mountains. These clouds occur when: the wind direction is perpendicular to the mountains through a deep layer, the mountain top wind is a minimum of 20 kt., and the atmosphere is stable for vertical displacements of air. Satellite photographs show that the unique parallel arrangement of small wave clouds is common to all major mountain chains throughout the world. In the United States, lee waves are frequently observed, as in this case, along the northwestern ranges.

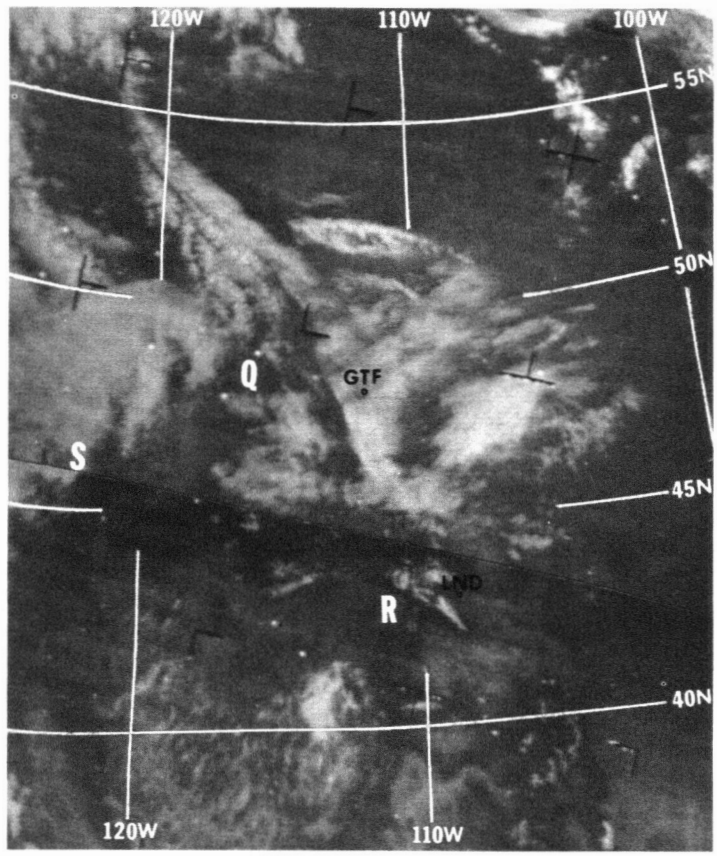
On June 21, 1968, the 1200 GMT analysis showed a weak surface High centered in Wyoming with a low pressure area off the Washington coast. The 500- and 300-mb. analysis showed strong zonal flow across the northwestern United States. At this time, the 200-mb. jet stream was analyzed to cross the coast near Seattle and follow a path, due east, along 48°N. through Idaho and Montana and then northeastward into Canada.

Upper air soundings for 1200 GMT at Lander, Wyo. (LND), and Great Falls, Mont. (GTF), accompany the 1435 GMT ESSA-2 photograph in figure 1. At this time, low clouds are present near LND and middle and high clouds at GTF. Little directional wind shear is indicated at both these stations.

The ESSA-5 picture (fig. 2), taken at 2309 GMT, shows that late morning and early afternoon convection in this area has resulted in a large area of wave clouds through Idaho, Montana, and Wyoming. The 0000 GMT soundings at both stations show the lapse rate to be dry adiabatic up to the base of the inversion. At GTF the winds aloft have increased due to a shift in the jet stream; now entering the coast at 49°N., it continues eastward to 115°W. and gradually turns southeastward passing through the extreme southwest corner of North Dakota.

The brightest group of wave clouds (Q) is found near the 6,000- to 9,000-ft. Cabinet Mountains and the Bitter Root Range. The clouds become more widely spaced to the east in the vicinity of the Rocky Mountains of Montana. The upper air data at GTF indicates that the wind at the mountain top level is greater than 26 kt. from the west-southwest.

The wave cloud pattern to the south (R) is in the vicinity of the higher Rocky Mountains in Wyoming and



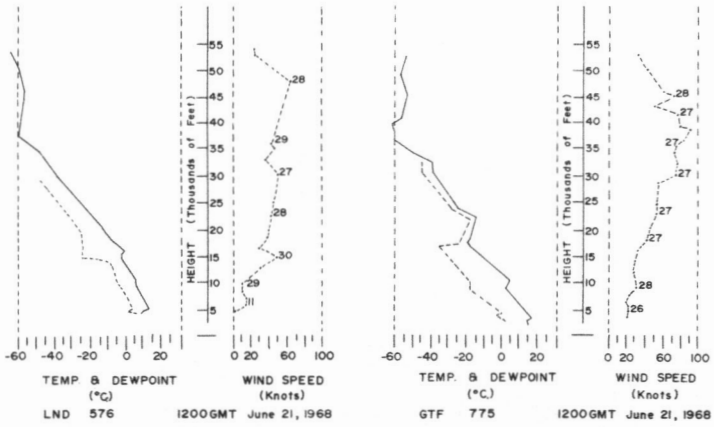
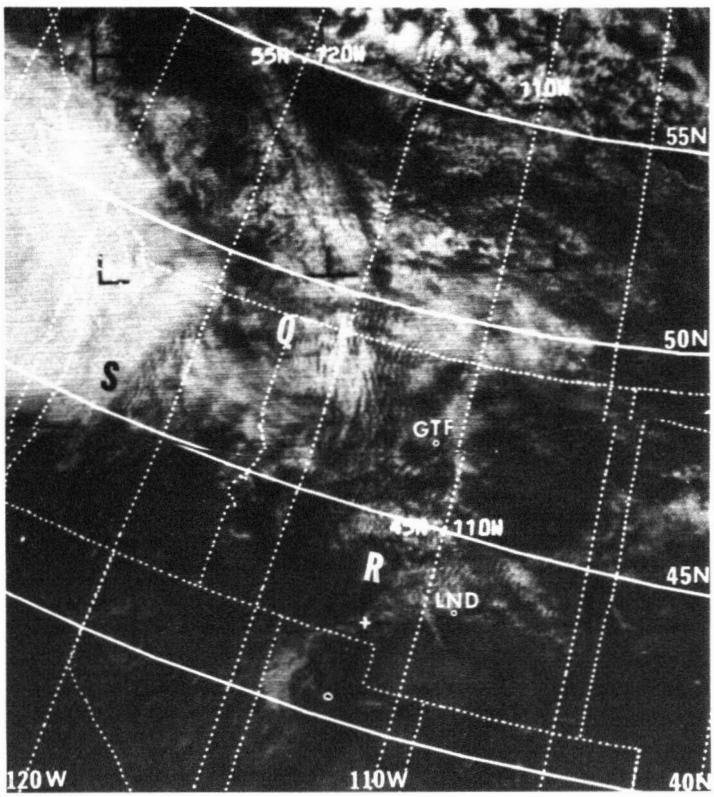


FIGURE 1.—ESSA 2, APT, Orbit 10705, 1436 GMT and 1200 GMT, upper air soundings for Lander, Wyo. (LND), and Great Falls, Mont. (GTF), June 21, 1968.



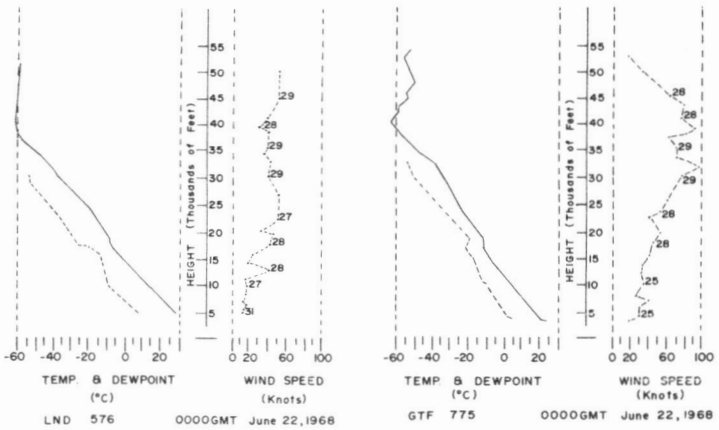


FIGURE 2.—ESSA 5, Orbit 5431, 2309 GMT, June 21, 1968, and 0000 GMT, upper air soundings for Lander, Wyo. (LND), and Great Falls, Mont. (GTF), June 22, 1968.

southern Montana. These clouds lie to the north of Yellowstone Park, and along the north-south Absaroka and Wind River Ranges, and farther east along the Big Horn Mountains. The wind at the top of the 12,000- and 14,000-ft. mountains, indicated by LND, is 40 kt. from the west.

Another area of wave clouds (S) can be seen along the eastern edge of the frontal cloudiness approaching Washington and Oregon, in the vicinity of Mt. Adams and Mt. Hood.

The presence of wave clouds in satellite photographs provides the aviation forecaster with visual information about the mesoscale wind patterns and general atmospheric structure in the vicinity of mountainous areas. Although the distribution of turbulence associated with lee waves is still under investigation, some preliminary results indicate that the turbulent layer is confined to the area within and below these clouds. Soaring and glideplane pilots were among the first to investigate wave clouds, and by flying these clouds, these pilots have established new height and distance records. Using the same technique, light aircraft pilots have found that they can conserve fuel by "riding" the wave clouds.